Some Constraints on Possible Words

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Some constraints on possible words

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1. An examination of the lexicon of English or any other language will reveal that the verbs are divided into several groups as far as the number of «inherent arguments» is concerned[1]. Although we will be led te revise this definition later[2], for now let us call the inherent arguments (IA) of a verb those arguments which meet the following criteria:

1) They can be represented by NPs in a simple sentence containing the verb
2) Even if these NPs are not present in the sentence, they are present in some sentence entailed by the original sentence
3) This entailment cannot be predicted by general rules

For example, the verb « die », in the sentence :

(1) John died.

has just one IA since (1) does not entail any sentences of the form :

(2) ...NP_i...

where NP_i is distinct from « John », except sentences where NP_i is predictable by general rule. Among such sentences are perhaps :

(3) John died from some cause.
(4) John died at some time.
(5) John died in some place.

The entailment relations between (1) and (3), (4), and (5), are predictable by the general rule : « every event has some cause, happens at some time, and in some place ». It is sufficient to indicate that « die » refers to an event[3], a property it shares with thousands of other verbs, to derive thse entailments. Since « die » requires a subject, does not permit a non-cognate direct object, and takes no prepositional objects which do not also occur with many other verbs and do not involve IA, we can say that « die » is a verb with one IA.

1. The research partly reported on in this article has benefited by observations, arguments, and counterexamples from too many people for a brief note to hold. Some of them, chosen almost at random, are R. Kayne, J.-P. Boons, E. Williams, M.-N. Gary-Prieur, O. Jaeggli, J. Katz, M. Borel, N. Ege, N. Ruwet, M. Jones, R. De Rijk, S. Schlyter, J. Fodor, O. Ducrot. Thanks to G. Fauconnier for reading and commenting abundantly on the next to last draft.

2. See section 10 below.

3. For discussion of how the fact that « die » is an event verb might be predictable from its semantic representation, see section 10.

On the other hand, « eat », which can occur in :

(6) John ate.

seems to be a verb with two IA, since (6) entails

(7) John ate something.

That is, « eat » differs from « die » in entailing a sentence with a non-cognate direct object. Moreover, this entailment of (6) does not seem predictable by a general rule. To avoid having this be trivially false, we must say what kind of general rule is meant. One could assign verbs like « eat » a feature T and then predict the entailment from (6) to (7) from T. We rule out this move by disallowing as general rules that use an otherwise unmotivated feature. It will be apparent later that to allow such rules would not be very harmful. They would merely lead to a rather unrevealing notational equivalent of the approach we will develop. We rule them out by definition because they tend to obscure the empirically real difference between, for example, « die », and « eat », which is in question.

« Die » and « eat » contrast with verbs like « load », since

(8) John loaded the wagon.

entails

(9) John loaded the wagon with something.

While « die » does not express a relation between its subject and some other entity whose existence is unpredictable, and « eat » expresses a relation between its subject and one other entity, « load » expresses a relation between the loader, the load-bearer, and the load. Other verbs with three IA are « give », « pay », « paint », « poison », « bank », « deprive », « communicate », etc.

The verb « trade », as in

(10) John traded his cobra to Mary.

has four IA, since (10) entails (11) :

(11) John traded his cobra to Mary for something.

If all the verbs of English on all their senses were classed in terms of the number of IA, it would be found, I believe, that none had more than four IA. Here are some further examples of each group. It will be seen that some verbs figure in more than one group :

one IA : exist, redden, stink, rise, grow, tremble, revolve, laugh, cough, melt, vibrate, disappear, growl

two IA : redden, create, have, strangle, push, grow, believe, know, see, open, learn, belong, resurrect, annul, mother

three IA : teach, toe, pocket, steal, touch, festoon, strangle, exile, divide, scoop

four IA : exchange, buy, sell, send

It is easy enough to invent verbs with meanings that would require the mto have more than four IA, for instance a verb « glack » such that

(11) The chair glacks the door, the window, the bed and the table.

would express a spatial relation between these five objects, « glack » meaning « to be in the middle of four objects ». Or a verb « bloof », where

(12) Bob bloofed the cake.

would mean, and entail :

(13) Bob ate the cake with someone in a house for money at noon.

That is, « bloof » would have six IA, and « glack » five. The observation that no such verbs exist would be of some interest to anyone who wanted to develop an explanatory theory of the lexicon. The problem would be to explain why no verbs with more than four IA exist.

2. If we attempt to class the verbs of English according to their relative semantic complexity we will find that, for a certain kind of complexity, there is a rather low upper limit on the degree of complexity possible. For example, we will find some verbs which have a causative sense, such as « kill », « persuade », « hit », « tickle », « amuse », « bomb », « open », « walk », « swallow », etc., and some verbs which do not have a causative sense, such as « know », « see », « be », « become », « belong », « have », « contain », etc., where by « have a causative sense » we mean at least « entail a sentence containing the verb 'cause', where this entailment is not predictable by general rule ».

To be more specific, there are certain verbs such that, when they occur in sentences of the form

(1) NP_1 verbed ... (NP_2) ... at t.

such a sentence entails a sentence of the form

(2) NP_1 caused something at t.

Thus « John tickled Mary » entails « John caused something to come into contact with Mary », and « the creature walked » entails, I think, « The creature caused its legs to move ».

This criterion divides the lexicon into two very large groups, with many verbs having both a causative and a non-causative sense. Further examples of each type are :

causatives : strangle, eat, dance, redden, load, give, paint, poison, bank, deprive, touch, bus, communicate, say, scoop, exchange, bark, father

non-causatives : exist, redden, stink, rise, tremble, melt, disappear, strangle, die, believe, learn, receive, flow, divide, own, want

We further observe that among the causatives there are some for which, when they occur in a sentence of form (1), that sentence entails a sentence of the form

(3) NP_2 verbed at t.

which in turn entails a sentence of the form

(4) NP_2 changed at t.

For example, in the following sets the (a) sentence entails the corresponding (b) sentence :

(5) (a) John killed Bill at noon.
(b) Bill died at noon.
(6) (a) John struck Bill with a knife at noon.
(b) A knife moved at noon.
(7) (a) Ruth persuaded John to leave at noon.
(b) John decided to leave at noon.
(8) (a) Ruth paid John $1000 at noon.
(b) John received $1000 at noon.
(9) (a) Harry informed the police at one.
(b) The police learned something at one.
(10) (a) The police jailed John at two.
(b) John entered jail at two.
(11) (a) John ate Ruth's cake at three.
(b) Ruth's cake entered John's digestive system at three.
(12) (a) The cake poisoned John at three.
(b) John's system changed at three.
(13) (a) The poison finished John at three.
(b) John ceased to be alive at three.

We can represent this capacity of verbs like « kill », « strike », « persuade », etc., to enter into entailment relations with verbs like « die », « move », « decide », etc., by assigning the former a lexical representation containing the element « CAUSE », as in (14) :

(14) kill : ...CAUSE...

As a first approximation to what we will call the « semantic representation » (SR) of « kill », we can propose :

(15) SR (kill) : x CAUSE (y DIE)

For much of what follows, the empirical claims made will be unaffected if our talk of SRs is replaced by talk of idiosyncratic entailment rules. We assume a theory with a set of rules of inference (RI) to account for general entailment relations between sentences, and with SRs in the lexicon to account for non-general ones. In a theory where *all* entailments, general or specific, are to be accounted for by RI, there will have to be a large set of RI which will have to be associated with individual senses of lexical items. A reader who favors such an approach can regard our SRs as essentially equivalent to the right sides of such idiosyncratic RI. For instance, if the most fully specified yet redundancy-free RI for « kill » was « NP_i kill NP_jNP_i CAUSE (NP_j DIE) » the right side of this rule would be essentially equivalent to (15). It is not clear just what issues of fact separate these two ways of talking. I adopt the SR approach because it is less cumbersome, because SRs seem to be more amenable to systematic investigation, and because I believe there are arguments in its favor. Since these arguments have to do with the interaction of lexical semantics and sentence meaning and form they are beyond the scope of this paper.

A further warning is relevant : typically the SRs we propose will be only approximate, either (a) because certain analyzable elements, like the « DIE » in (15), are not analyzed (sometimes because further analysis is irrelevant to the point under discussion) ; or (b) because additional elements of meaning are not mentioned. The reader is asked to interpret such SRs as (15) as if they said « x CAUSE (y DIE)... etc... », where « etc. » stands for a possibly null sef of semantic elements whose position may be elsewhere in the structure. Thus, in the present case, we are not prejudging the question of whether (15) is an exhaustive specification of the meaning of « kill ». There is no need either to prejudge the question of whether, once a SR has been found which will in combination with a set of RI account for all the entailment behavior of « kill », that will exhaust what can be said about the meaning of « kill ». It is sufficient to note that mere concern about providing a representation of a word W that accounts for the idiosyncratic entailment behavior of W will take us very far in the direction of a complete account of the meaning of W.

To return to the point at issue, if we assign to each verb sense of English a representation of the form (14), with one occurrence of « CAUSE » for each layer of idiosyncratic causativeness we find, the observation we make concerning the upper limit on possible complexity of a sense will be the following :

(16) there exists a number n such that there is no verb in the lexicon to which we are led to assign a SR with more than n occurrences of « CAUSE »

The problem of determining n has a certain complexity, since there is a difference between the number of « causes » entailed by a particular verb (that is, by sentences containing that verb, where the entailment can be attributed to no other form of the sentence but that verb), and the minimal number of « CAUSEs » that will suffice to account for these entailments. In other words, if we adopt the program of constructing a system of SRs and rules that will account for such entailments in the maximally general way, we will find that certain entailment relations involving « cause » are predictable by general rule. One such rule has already been noted. If every event has a cause, then every event verb will participate in the entailment relation exemplified by (17) and (18) :

(17) John died.
(18) Someone or something caused John to die.

Many would affirm that (17) entails (18), but this is not an entailment relation of the type we have been considering to motivate inclusion of « CAUSE » in the SR of a verb. For one thing, given (17), we do not know who or what did the causing. Furthermore, it is in principal impossible to account for such entailments by putting « CAUSEs » into

the SR of a verb, since the relation is iterative : (18) denotes an event, and if we believe that every event has a cause, then we should believe that someone or something caused someone or something to cause John to die, and so on back to the first causer, or back forever. What is more, the principle evoked here, that every event has a cause, seems more a metaphysical than a semantic one.

However, there may be other « cause »-entailments which are general, though applying to much more restricted domains, since there are fewer verbs whose SRs meet the structural description of the rule deriving them. For instance, four-IA verbs of exchange like « trade » plausibly involve at least two occurrences of « CAUSE », but they might be related to entailed sentences with four or more occurrences of « cause ». Thus it is not a wildly implausible claim that (19) entails (20) :

(19) John bought a book from Bill for ten dollars.

(20) John's desire to have the book caused$_1$ John to cause$_2$ ten dollars to cause$_3$ Bill to have a desire to have the ten dollars which caused$_4$ Bill to cause$_5$ John to have the book.

Whatever the maximum number of entailments from « buy » to « cause » is, it is apparently shared by all verbs of exchange and no others, and if this is so, and if verbs of exchange have a common core of SR which distinguishes them from all other verbs (if they did not, then our semantic theory would fail to characterize correctly our intuitions concerning natural semantic classes of verbs), then conceivably the rule or rules which predict sentences like (20) from sentences like (19) will permit verbs of exchange to be represented with only two occurrences of « CAUSE ».

In fact, there seem to be in the lexicon of English no formally simple (i.e. non-derived) verbs where n is greater than two, and this applies not only to the element « CAUSE », but to all elements we might be led to introduce in a parallel fashion to account for the entailment relations of verbs. A detailed demonstration of this would go far beyond the limits of this article, since it would have to examine in detail the SRs of hundreds, at least, of representative verbs, to defend each SR proposed, and to show that none really violates this generalization. We can, however, give a brief, approximate demonstration of the plausibility of this claim.

To begin with the causatives, we note that often, when we take a verb V_1 which is not causative, for example « rise », we can find another non-derived verb V_2 which is causative, such that V_2 entails V_1. Thus (21) entails (22) :

(21) She raised the hat.

(22) The hat rose.

Furthermore, (21) entails (23) :

(23) She caused the hat to rise.

Among the many sets of verbs exhibiting such a relation are[4] :

V_1	V_2
die	kill, strangle, assassinate
receive, have	give, grant, award, pay
break	break
exist	create, write
enter	insert
move	hit, throw, walk
leave	expel
believe	convince, persuade
learn	inform, teach
lose	steal
flow	pour
lie	lay
own	bequeath

What is common to all these sets is that for each V_1 there is a sentence of the form « ... cause to V_1 ... » such that it is entailed by some sentence containing the corresponding V_2. It is not the case that all of the sentences with V_1 are of the same form. For instance, while (21) entails (23), (24) entails (25) :

(24) Sam stole a boat from Sid.

(25) Sam caused Sid to lose a boat.

The object of « raise » is the subject of « rise », but it is not the object of « steal » that is the subject of « lose ». It is even less true that the entailed sentence is a paraphrase of, or entails, the entailing one : typically, that is not the case.

While we find many such, what we do not often find is sets where V_1 is itself causative. Thus we do not find a verb « stig » such that (26) would entail (27) :

(26) John stigged Bill ...

(27) John caused Bill to kill ...

4. A problem arises with the pair « fall », « drop » : does (i) *John dropped the hat* entail (ii) *John caused the hat to fall* ? I think it does, but with a more complex kind of causation involved. Some would deny the entailment, saying that there is no difference between the « drop » of (i) and that of (iii) *The tree is dropping its leaves*, and that surely with (iii) there is no entailment of « cause ». I would argue that (iii) is metaphorical, as is suggested by our reluctance to use « drop » in general when there is no causation by the subject. I think I would not say, of a leaking pot, (iv) *The pot is dropping water on the floor.* Or consider a man walking down the street — a handkerchief falls out his back pocket, and we say (v) *You dropped something*, with no intention of being funny, because, I think he put it into his pocket to carry it with him — he was controlling it and now he has lost control. But if his back pocket itself fell off, say because moths had eaten the thread holding it on, we would not say (v) except in jest. It seems more appropriate to express the less active kind of causation of « drop » or « let » in terms of « CAUSE » plus additional material, rather than with a new primitive « LET », in view of the relative rarety of this element in verb meanings.

If « exchange », « send », etc., might be argued to involve « cause to give », and « walk » of « He walked the horse around the yard » to involve « cause to walk », for most of the V_2 given above no verb entailing « cause to V_2 » can be found. We find that, while many verbs are analyzable as

(28) x CAUSE (y $VERB_i$ ...

there are great restrictions on what $VERB_i$ can correspond to, and one of these restrictions is that, for all but a small subset of verbs $VERB_j$, $VERB_i$ cannot be or contain « CAUSE ». Furthermore, as far as I know, there is no verb of English that is analyzable as « x CAUSE (y $VERB_j$... »

What is true of causatives is even more true of verbs with other types of semantic complexity. In parallel fashion to what we did to obtain sets consisting of a non-causative verb entailed by a causative, we can construct pairs where one element, V_0, is entailed by a V_1 according to the pattern illustrated by (29) and (30) :

(29) Bill became a sailor at t.

(30) Bill was a sailor after t.

In fact (29) entails (31) :

(31) Bill changed from not being a sailor to being a sailor at t.

In these pairs V_0 is a stative verb, and V_1 expresses entering into the state involved. We can represent this relationship as

(32) SR(V_1) : x CHANGE (x V_0 ...

In English the number of such pairs seems to be rather small. Some examples are :

V_0	V_1
have	receive
be	become
know	learn
lack	lose

Even some of these are debatable. Some might want to argue that « learn », for instance, is also causative. Thus, while (33) (a) entails (33) (b), it might be contended that (b) entails (c) :

(33) (a) Tom taught the rat to run a maze.

(b) The rate learned to run a maze.

(c) The rat did something active which caused it to know how to run a maze.

This is disputable. It is not really compelling that imperative sentences involving causation are found with « learn, e.g.

(34) Learn this by Monday.

unless a convincig argument can be given that the « CAUSE » perhaps present in (34) is not simply to be attributed to the imperative morpheme rather than to the lexical item « learn ». As earlier with « die », one has the feeling that a belief that all learning is caused by the learner is based on a certain view of the nature of the world rather than on one's knowledge of the meaning of « learn ». Some would deny that these can be distinguished, but even so all is not lost for excluding the alleged cause-entailment of « learn » from consideration in the lexicon. It may be the case that those who believe that (33) (b) entails (33) (c) would be willing to accept the general principale : any « mind » causes its internal changes of state. In that case supposed entailment would be predictable and thus not an idiosyncratic entailment of « learn » meriting a « CAUSE » in its SR, since in any event for « learn » there must be something in the SR corresponding to « mind ».

One reason for the paucity of such pairs of V_0 and V_1 is that the class of possible statives is highly restricted in English. It is so restricted, in fact, that the presence of « CHANGE » in a verb semantic representation (VSR) can be predicted, by a rule we shall call « RR-CHANGE », in most, but not all, occurrences. A verb meaning « to be red » is not a possible verb in English, nor is any verb of the form « x BE ADJ », where « ADJ » represents what we may call a « semantically simple adjective ». For present purposes this includes many, perhaps all, formally simple adjectives, but excludes adjectives like « asleep », « atremble », « mobile », « prosperous », etc. Since no such verbs exist, we might enter verbs like « redden », « melt », « die », « grow », etc., in the lexicon in the form « x BE ADJ » and have RR-CHANGE insert « CHANGE ». Thus « redden » would have the SR « x BE RED » and RR-CHANGE would change this to « x CHANGE (x BE RED) ». We will modify this proposal and formulate RR-CHANGE more precisely below.

Another environment in which the presence of « CHANGE » is predictable is under « CAUSE », since there is never a contrast between « x CAUSE (y CHANGE (y ...)) » on the one hand, and « x CAUSE (y ...) » on the other. That is, there does not seem to exist in English any pair of verbs such that the meaning of one is to be characterized as « to cause to $verb_i$ » and of the other as « to cause to $verb_j$ », where $verb_i$ differs from $verb_j$ just by « CHANGE ». There are, for instance, no pairs « cause to die » and « cause to be dead », « cause to have » and « cause to come to have », etc.

Since the presence of « CHANGE » is predictable in VSRs with « CAUSE » we can eliminate it from them and thus claim that for « kill », for instance, the complexity, measured in terms of levels of embedding of primitive verbal elements, which we will call « V-PRIMEs », in the redundancy free lexical representation, is not three but two. « Kill » will have the SR

(35) x CAUSE (y BE DEAD)

since the presence of « CHANGE » is predictable. What we seem not to find, for verbs with unpredictable occurrences of « CHANGE », is cases of VSRs with more than one occurrence of « CHANGE ».

We have so far considered briefly cases of formally simple verbs where there is reason to believe the verb in question is semantically more

complex than certain other verbs, on the basis of its entailment behavior, and where this complexity was plausibly to be assigned at least partly to the V-PRIME « CAUSE » or « CHANGE ». It remains to consider all other cases where there is reason to believe that such complexity exists and where it cannot be assigned to either of these elements. This discussion will be brief since, for relational primitives, I know of no such cases[5] that are really plausible. We can imagine what such cases might look like. For instance, « WANT » would be a reasonable candidate for a V-PRIME. Furthermore certain languages have an affix which, when added to a verb, creates a form translatable as « want to verb », although this affix is perhaps not as widespread as the causative or inchoative (i.e. CHANGE) affixes found in many languages. Why should we not find English verbs glossable as « to want to eat », « to want to be », etc. Someone might even suggest that a verb like « root », defined by MW7 (see bibliography for this and subsequent abbreviated references) as « to wish the success of or lend support to someone or something », was such a case. Strictly speaking, even if it could be represented with WANT plus another V-PRIME « root » would not be the case we would need to disconfirm the statement that no F-simple verbs of that form occur, since it is not an F-simple verb, but a verb-particle combination : « root for » is what has to be listed in the lexicon for this sense, and not « root » alone. But suppose we could say « John rooted the Tigers » with exactly the meaning of « John rooted for the Tigers ». Would this then be a counterexample ? That is dubious : one might propose the SR (36) or (37) :

(36) SR (root) : x WANT (y WIN)

(37) SR (root) : x WANT (y SUCCEED)

Clearly, the first is too specific. We can say

(38) John is rooting for Bertha.

whether Bertha is engaged in a boxing match or is being operated on, but we do not usually speak of « winning » an operation. But we do not speak of « succeeding » in it either, for the patient, although we can say that the operation was a success. Another difficulty is this : while we can with « root » specify what the content of the rooter's wish is, as in

(40) John is rooting for Bertha to beat big Suzie/recover/survive/ succeed.

we cannot do this in clear cases of incorporation of a verbal element. For instance, we cannot say

(41)* John killed the snake to death/ to die/till it was dead, etc.

5. We are focusing here on relational primitives, i.e., predicates of at least two places. We will take up in section 9 the question of how negative and modal elements of meaning contribute to lexical complexity. We note for now that these elements do not seem to violate the claim that n=2 either, for instance no verbs seem to exist with meanings like « to cause someone to cause someone to have to leave ».

Furthermore, none of the alternative endings of (40) gives the sense of redundancy we might expect if the added material added no new meaning. All this casts doubt on the proposal that « root » is a case of the type we are looking for, a case with some verbal meaning embedded to WANT. Even if we found such a clear case, it would not clearly be a counter-example to the generalization that the upper limit for such complexity was three, unless the embedded element was itself complex. In fact, even if examples were found that motivated analyses of the form (42) or (43) :

(42) x WANT (y CAUSE (z $VERB_i$))

(43) x CAUSE (y WANT (y $VERB_i$))

or other such combinations, they would not be counterexamples unless it could be argued that $VERB_i$ was itself complex.

For want of examples, then, we provisionally conclude that the maximum « depth of embedding » of V-PRIMEs for formally simple verbs is three, when we consider redundancy-free SRs, and that the only way to attain this maximum is through two occurrences of CAUSE followed by a stative verb sense. Furthermore, verbs with two CAUSEs are rare and seem to be subject to further restrictions.

As we have shown, it is easy enough to invent verbs with meanings that would require them to have more than two occurrences of CAUSE, or CHANGE, or WANT, or any plausible combination of these or any other plausible V-PRIMEs, such as HOPE, KNOW, SAY, etc. Such verbs seem not to exist. There are no verbs with meanings like « to hope that someone will cause one to try to leave » or « to cause someone to cause someone to cause someone to have », or « to begin to cause to cause to have », etc. The observation that no such verbs exist is of some interest to anyone who wants to develop an explanatory theory of the lexicon. The problem is to explain why no verbs with more than three V-PRIMEs exist.

3. Before making a proposal for the solution of these problems, we will examine briefly some others of the same type. Such problems concerning the nature of and constraints on the lexicon are numerous. There is even a general procedure for their discovery : one studies the lexicon of a language, trying to find, for each word, a SR which allows the correct prediction of its behavior with respect to entailment relations and all other semantic relations and properties. Then one examines the form and content of the set of SR, and attempts to formulate general principles governing the structure of the lexicon. In the course of doing this, one constantly asks questions about the existence and non-existence of SRs of various types. Needless to say, the questions have an empirical status which transcends the particular theoretical framework in terms of which they are asked. They can be asked in terms of dictionary defini-

tions given in words, of meaning representations of any type, or even, although more cumbersomely, in terms of rules of implication. Asked systematically, these questions will lead to the discovery of limits and gaps, systematic or accidental, in the lexicon.

Among the particular observations that can be made about the lexicon of English are these :

There is no verb of English which means :

(a) « cause to kill »
(b) « cause to cause to dance »
(c) « change from being yellow to being red »
(d) « begin to sneeze »
(e) « be sick and then be well and then be sick again »
(f) « go to England »
(g) « become happy »
(h) « put paint or chalk on »

Among the true generalizations about the lexicon are, I believe, these :

There is no verb sense representable as :

(a) x CAUSE (y CAUSE (z BE ADJ))
(b) x CAUSE (y CAUSE) (z CAUSE ...))
(c) There is no verb meaning « change from one specific color no another »
(d) There is no verb meaning « begin to $verb_i$ », where $verb_i$ contains CAUSE
(e) There is no change of state verb which asserts the existence of three or more states (« relapse » is not a counterexample, since it asserts something about the passage from health to illness, it being presupposed that the subject was previously ill of the same illness. That the first state is not included in the assertion is shown by its being outside the scope of the adverb in « John relapsed yesterday »)
(f) There is no verb meaning « go to P » where P is the name of a place
(g) There is no SR of the form (x BE ADJ) where ADJ expresses an emotional state
(h) there are no VSRs with conjunction or disjunction
(i) there are no verbs with a meaning that can be characterized this way : to change from a state which can be described by a sentence of the form « NP_i be Adj_i » to a state described by « NP_i be Adj_j » except when either (i) Adj_j is equivalent to « not Adj_i » ; or (ii) Adj_i and Adj_j belong to one of a small number of specific classes of adjectives. This is a generalization of (c). Most verbs which are morphologically derived from adjectives, such as « redden », « enlarge », or which, like « die », « shrink », are F-simple but have an adjectival sense in their SR, are either change of state verbs, causative of change of state verbs, or both, and they have the property that they « exhaust » their domain. The domain of « redden » is the domain of « red », that is, of possible color adjectives, and « redden » means to pass from the state of being not (or less) red to the state of being (more) red, these two complementary states covering all possible color states. However there seems to be a very small number of verbs for which this does not hold. The verbs I know of are verbs of change of physical state where the states involved are solid, liquid, and gaseous : while « liquefy » means « change from non-liquid to liquid », « melt » means « change from solid to liquid ». There are also perhaps some verbs in English I have not yet found which are morphologically derived from adjectives but which are not verbs involving change of state. French has « rougeoyer », « prospérer », German « blauen », Swedish « blåna ». Of these examples, the color verbs tend to be literary. French « prospérer » like « prosper » in English, does not mean « become prosperous » or «begin to be prospérous », but rather something more complex : it is a durative verb roughly equivalent to « flourish », « thrive ». The adjective « prosperous » is also aspectually more complex than most adjectives. Since such verbs are not change of state verbs, they are not relevant to the generalization stated here.
(j) There is, in general, no English verb equivalent to an expression of the form « be adjective », and the limited possibilities in this domain appear to all be durative verbs. It will thus be necessary to explain why no verb « reddle » exists meaning simply « be red ». There appear to be languages, e.g. the Bantu languages' where such verb meanings are found. It furthermore seems to be the case for English that durative verbs associated with adjective meanings are quite restricted. Thus we find none for most classes of adjectives : there are no verbs meaning « be red/small/cold etc. for a while ». Note that, while English seems to have no verb meaning « become happy » (this follows from generalization (g) since if there were a verb with the SR « x BE HAPPY » then RR-CHANGE, mentioned earlier, would insert CHANGE giving it the meaning « become happy ») it does have the verb « rejoice ». This is defined by ALD3 as « feel great joy ; shown signs of great happiness » for the sense in « John rejoiced at Polly's success ». ALD3 observes that this verb is not common in colloquial use. Furthermore, « rejoice » is not durative, and cannot take the progressive easily, as can verbs like « thrive », « flourish ». It also, unlike these verbs, requires a complement : *John rejoices. This suggests tightening of the present generalization to a statement that there are no verbs meaning « be adjective » where the adjective is non-durative and intransitive.
(k) there is no verb paraphraseable as « to $verb_i$ to $verb_j$ ... » except where $verb_i$ is « cause ».

4. As a help towards the solution of such problems we propose that the regularities governing lexical structure and the constraints on possible SR be captured, and, if possible, explained, by an approach which proceeds

as follows : we will attempt to construct a system of rules which specifies all and only the possible SRs of F-simple and F-complex words, using as well motivated a system of semantic representation as we can find. This system of rules, which we may call the « grammar » (G) of the lexicon, we will formulate, as a first approximation for heuristic purposes, as a generative grammar which is to specify as closely as possible the set of SR actually needed for the description of the language in question. We will try to formulate the grammar so as not to engender a SR not used for some existing word, except when the SR in question cannot be excluded in general. We can call such unused SR « accidental gaps » in the lexicon.

As an example of a grammar of the lexicon which will help us solve the first two problems we discussed, the problem of the maximum number of inherent arguments and the problem of the maximum depth of embedding for V-PRIMEs, consider the following fragment of a G for English verbs : G-VSR :

1. VSR → A V-PRIME A
2. A → { NSR / ADJ-SR / VSR }

This set of rules says that a verb semantic representation consists of a primitive verbal element flanked by two argument positions, which we will call « Al » or the « left-A » and « A2 » or the « right-A » of the V-PRIME. It therefore embodies the debatable claim that all primitive verbal notions are two-place relations. Rule 2 states that an argument place can be occupied by one of three types of entities : either (a) a noun meaning (NSR), which is to be chosen from a perhaps open-ended list of possible NSRs which are a subset of the set of possible NSRs of nouns, the latter set to be specified by a grammar of NSR similar to those for VSRs, ADJ-SRs, etc. ; or (b) a member of the set of ADJ-SRs permitted in VSRs ; or (c) a VSR. We assume that the rules are optional, and thus there is a fourth possibility, namely that A will be developed as nothing at all, an option which we will represent, for expository purposes, by using the variable symbols « x », « y », etc. Among the ways in which G-VSR is incomplete are these : NSR and ADJ-SR are not further developed, and needed elements which are perhaps not two-place predicates, such as the negation and modality operators, are ignored.

To generate anything at all, our G must be associated with a « lexicon » of primitives, containing the V-PRIMEs and their characterization. Since these are primitive semantic elements, it is impossible by definition to define them, but it is necessary to relate them somehow to something nonlinguistic for our use of them to represent an empirical claim. One approach would be to characterize the semantic primitives in terms of a « conceptual system » conceived of as a system with « procedures » for

dealing with the real world. The correspondence of primitives to procedures might be direct, one primitive corresponding to one procedure, or indirect, something more like the way a weather map corresponds to the weather.

One example must suffice : we might associate CAUSE with a procedure or set of procedures for determining whether, in various circumstances, a given event or state of affairs was caused by some entity. There is no need to require that the procedures usually give a clear answer, or the right answer. We can imagine different creatures with different conceptual systems, that is, different procedures, those of one creature being more efficient than those of another. We can also imagine that in one creature they are fixed, i.e., for natural creatures, innate, for another partly learned. On this view study of the facts of organization of the language of a creature might lead to insights into its pre-linguistic internal structure.

We will not pursue this proposal here, but will instead take the characterization of our primitives for granted, as is typically done in semantic theory, asking only that the proposed set of primitives be justified on theory-internal grounds, and that each primitive be clearly graspable as a plausible candidate for one of the basic semantic notions. For instance, we prefer less obscure terms like CAUSE to more obscure terms like AGENT.

Lets us assume the following partial list of V-PRIMEs : CAUSE, BE, HAVE, WANT.

For each V-PRIME we must list its possibilities for co-occurrence with the other elements in the structures generated by G, if these are not deducible from its characterization. CAUSE can have embedded to it any of the V PRIMEs, BE and HAVE do not accept VSRs as arguments. Assuming that these co-occurrence restrictions are specified in our lexicon of primitives, our G will generate the following VSR, among others :

(a) x CAUSE (y BE DEAD)
(b) x CAUSE (y HAVE z)
(c) x CAUSE (y HAVE MONEY)
(d) x BE y
(e) x CAUSE (y BE z)

G will not generate, because of the filtering effect of the co-occurrence specifications, such structures as

(f) x BE (y CAUSE z)
(g) x HAVE (y BE z)

However G will generate in addition to such structures as (a) through (e), structures like

(h) x CAUSE (y CAUSE (z CAUSE (w CAUSE (v CAUSE (u HAVE t)))))
(i) x CAUSE (y CAUSE (z CAUSE (w BE WISE)))

Since many English verb senses exist for which structures likes (a) through (e) would be plausible SRs, while no verbs can be found, as far as I know, for which (h), (i), and the infinitude of similar structures would be plausible candidates as SRs, we might propose that the following filter be added to G :

F' : eliminate any VSR where there are more than two occurrences of CAUSE

But, as a matter of fact, this condition seems to admit of a more general formulation which will still allow, given a suitable enrichment of G, a sufficient variety of VSRs to represent all the verb senses of English :

F : eliminate any VSR which has a depth of embedding involving more than three V-PRIMEs

It will be observed that if each inherent argument must correspond to an A of the VSR then G-VSR plus F allows us to predict that there will never be a verb with more than four IA, and so correctly describes the generalizations noted in sections 1 and 2 above.

5. We have so far examined informally a certain number of plausible generalizations about lexical structure, and seen that there is a case to be made for some rather abstract limitations. It is necessary to investigate the regularities in greater detail, and with more precision. We will now develop further our notational apparatus, for some aspects of which we will eventually want to make empirical claims. It can be noted, however, that the dividing line between theory and notation is often hard to draw : it may turn out that what look like two theories making different claims can be shown to be intertranslatable. Furthermore, there is no guarantee that the theory which happens to be correct will be the most useful tool at early stages of investigation of the phenomena it treats. Thus, while it is perhaps the case that a theory of the lexicon which list lexical items in a fully specified form and incorporates a set of redundancy statements as part of an evaluation measure is empirically distinct from and more adequate than a theory which leaves « blanks » to be filled in by redundancy rules, since the latter process type of theory will be forced to make perhaps arbitrary choices of its minimal representations in some cases, it is tempting to conclude from recent history that process-oriented approaches are more fruitful in the early stages than listing approaches. This is perhaps because the listing approach makes the empirically weaker claim : if there are regularities it will state them, if there are not that's still okay. The listing approach is more flexible than the process one, and typically nothing very crucial depends on what those regularities are, so the investigator has no reason to do more than give a few examples to show how his redundancy evaluating mechanism operates.

I believe that the data we are considering is sufficiently interesting to warrant the adoption of an approach that will force us to confront it in all its eccentricity. While attempting to extract all the generalities we can find, we will be looking for, ultimately, a theory or model of the conceptual system which explains the data, and not merely a formal mechanism that can handle it. Consider the following analogy with the study of sound patterning. It could be argued that, in large part, the regularities that govern possible phonological structure have their origin in the physiological capacities of the phonating organs. Suppose we had no other access to the nature of those organs than the data of sound patterning in human languages. We might well be able to construct a chain of argumentation which would lead to a reasonably accurate model of them. There is no guarantee of this, but it is an interesting possibility.

Playing a crucial role in this process of figuring out the form of the speech organs would be various assymetries in the data which would lead us to ask what kind of sound producing apparatus it could be for which it would be natural that these assymetries exist. In some cases we might argue that the assymetries in the data be attributed to assymetries in the organs. For example, if all we knew about the speech of Martians was such data, and we observed that in Martian languages, unlike human languages, there was a strong tendency for a language to have more degrees of height for back vowels than for front vowels, one candidate for an explanation of this, to be considered further, would be the proposal that Martian « mouths » had more room in back than in front. Whether this hypothesis was better than others we might find would, as usual, depend on other considerations, other data. What we would be looking for would be a total hypothesis, a model, that explains the data in all its particularness better than any others available. To take a few more obvious examples of how this model construction would proceed, limitations on occurring consonant sequences should reflect limitations on the flexibility and mutual interactions of the lips, tongue, etc. The range of possible vowels would be different if we were able to alter the shape of our nasal as of our buccal cavity. Forked tongues, independently acting or doubled lips, retractable teeth, etc., would offer a quite different array of possibilities.

While, fortunately, the structure and capacity of the phonating organs is open to more direct study, it may be the case that no more direct access to the thinking « organs » is available than the data provided by the cross-linguistic regularities of lexical and other semantic structure. If the details of this data have a valuable contribution to make to the study of human cognition, then we cannot be content with a mere demonstration that some theory is rich enough to handle the data. We will want to know as precisely as possible what the data is.

Our position, then, is the hopefully non-controversial one that the data of word and sentence semantic structure is worth detailed study and description for those interested in the structure of the mind. In our attempt to develop an adequate and at the same time heuristically fruitful system of representation we will adopt the following approach. Since we are crucially interested in the limitations, the systematically non-occurring, we will go back a step from the « grammar » presented in section 4 to consider an even more impoverished proposal. When the pressure of counterexample becomes unbearable we will revise G to give it greater power, but only to the minimum extent needed to handle the new data. We thus adopt an approach different from that illustrated in the valuable studies of Katz, McCawley, Jackendoff, and others, where typically a quite general, hence much too powerful, mechanism is provided, and then constrained, but not sufficiently. We will try to focus as much on what is to be ruled out as on what is to be included.

Our task will be to attempt to reconcile two conflicting urges, the urge toward generality, which will lead us to formulate a set of rules that generate too much, and the urge towards impoverishment of the system, which will lead us to reduce the generative power of the system, say by introducing additional filters. Such filters will complicate G. The theory we ultimately arrive at will have rule-like statements about what a possible lexical structure is, that is, it will generate an infinite number of objects. However, this infinitude will be sharply limited. The creative spark which makes an infinitude of nouns, verbs, etc., available to a human language (not the same infinitude to each one, since some constraints are language-specific) is, we will try to establish, channeled in very specific ways.

A further word about the empirical requirements we might wish to place on G. One argument in favor of assigning words SRs in the lexicon is that doing this makes it possible to predict with a simple set of rules of inference, such facts about the logical behavior of a word as, for example the fact that « kill » entails « cause to die ». Another argument is that the SR enables us to state a number of interlocking regularities similar to those we have so far mentioned. Thus we have to establish a connection between the number of inherent arguments a verb has and the degree of embedding of V-PRIMEs in its SR. It is thus reasonable, when evaluating competing semantic theories, to prefer the one which best allows prediction of the syntactic behavior of each lexical entry from its meaning. If there is little hope that all of the syntactic behavior will be predictable, we can still try to construct G so that it will provide SRs which facilitate such prediction while accomplishing the other, more primary goals of semantic theory. Another of these goals is worth mentioning here : it is reasonable to ask that G permit a convincing characterization of the natural semantic classes of the language, grouping

appropriately verbs of change of color, verbs of change of state, performative verbs, adjectives of emotional state, etc. on the basis of formal and substantive criteria. A theory which provides a single set of SRs that accomplish these goals, other things being equal, is to be preferred to one which accounts fo these things separately.

6. In the remainder of this paper I will attempt to motivate successive versions of G-VSR, restricting attention mainly to formally simple verbs, although many of the restrictions involved govern formally complex verbs as well. Let us consider the quite simple grammar G1 :

G1: R1. VSR → A V-PRIME A
R2. A → VSR

F1 : eliminate any VSR which has a depth of embedding of more than three V-PRIMEs[6]

Associated with this system is the partial lexicon of V-PRIMEs :
CAUSE, BE, HAVE

We have pointed out that something has to be said about the co-occurrence possibilities of V-PRIMEs. Such combinations as those in (44) are not found, and the first two are absurd :

(44) (a) x BE (y CAUSE z)
(b) x BE (y HAVE z)
(c) (x BE y) CAUSE z

On the one hand, (a) and (b) make no more sense than

(45) (a) * John is Bill caused the accident.
(b) * Flo was Martha to have a book.

If BE and HAVE are to correspond even roughly to the meaning of « be » and « have », that is, if « x BE y » and « x HAVE y » are to be reasonably adequate as the SRs of « be » and « have », then BE and HAVE would seem not to be elements accepting VSR complements as right-A, although this makes sense for CAUSE.

On the other hand, our examination of verb meanings has turned up

6. The state of the art is clearly not up to a serious treatment of such basic questions as this : why does there exist no verb with more than three V-PRIMEs, i.e., why does F1 exist ? We can speculate that the answer might come from a general theory of cognitive capacity. Two candidates for an explanation come to mind : (a) the more complex a verb, the less useful it is — it is their relative uselessness that makes such verbs non-existent ; (b) the language learner's mind is not capable of associating such complexity with a single word. There are some thoughts that are too complicated for us to think that way — they have to be built up by syntactic means. Against the first proposal is the observation that many verb meanings do exist that are highly complex and of quite restricted use : c.f. « guffaw », « telescope », « prestidigitate », etc. Furthermore, some of the non-existent verbs excluded by F1 would be rather useful, for instance « x CAUSE (y CAUSE (z CAUSE (w DIE))) » : courts of law might be quite interested in establishing the chain of causation in a death in an industrial accident, etc. English provides them with the means for doing so — they can concatenate « cause » as many times as they want to — but what English does not provide is a way of speaking of such things with single lexical items.

no plausible candidates for SRs parallel to that in (44) (c). For instance, there is no verb meaning anything like « NP_1's being ADJ causes NP_2. Such a verb would be the « glurn » of (46) which would entail (47) :

(46) John glurned the accident.

(47) John's being drunk caused the accident.

A general way to rule out such VSRs as those in (44) would be to allow only right-A's to be developed as VSR, and to allow only CAUSE to accept a VSR as right-A. This could be achieved by listing in the lexicon of V-PRIMEs the co-occurrence possibilities of each element, and in fact some such device is needed anyway to account for the possible subjects and objects, etc., of verbs. For instance, it is a fact about the verb « cause », which presumably has the SR « x CAUSE y », that it can have virtually any kind of NP as its subject, but can only take NPs characterizing events or states as objects :

(48) (a) Maud caused the earthquake.
(b) The confusion caused Blake to become angry.
(c) *Geraint caused the paint.
(d) The fact that it was raining caused much amusement.
(e) *The change in temperature caused the fact that it was raining.

In (a) we find a person NP as subject and an event NP as object ; in (b) the subject is a state NP and the object complement is an event ; in the ill-formed (c) the subject is a person NP and the object a thing NP ; in (d), with a fact NP as subject and a state NP as object we have a normal sentence, but in (e) with an event NP as subject and a fact NP as object we have an odd sentence. We can represent this behavior of CAUSE by assigning it, in our lexicon of primitives, the entry :

(49) CAUSE : left-A = NSR right-A = EST

where « EST » symbolizes « event or state ».

By this device, we in effect claim that the possibility the primitive CAUSE has of taking a VSR, that is, the sequence « A V-PRIME A », as its right-A is identical to the possibility the verb « cause » has of taking an EST as its object. We have thus assigned a special status to EST expressions in our theory, and laid the basis for the claim that VSRs essentially are such expressions. The claim seems plausible, in fact, that the notion « stative verb » corresponds to the notion « verb whose VSR contains only a single V-PRIME other than CAUSE or CHANGE » and that the notion « non-stative verb » corresponds to the notion « verb whose VSR contains CHANGE or CAUSE ». Furthermore, it is plausible that the notions « state noun » and « event noun » parllel the verb notions, with the essential difference that such nouns, like all nouns, exhibit the normal forms of NSRs, which we can symbolize as « x SUCH THAT ... ». A further claim of interest embodies a strong proposal, the proposal that all co-occurrence facts of the type illustrated in (48), i.e. selectional restrictions, can be predicted from SRs, and that thus there is never any need to indicate selectional restrictions in the lexicon.

7. Clearly, G1 is seriously deficient. Combined with F1, and with the filtering effect of such co-occurrence specifications as (49), it generates only a handful of VSRs, and this conflicts with the fact that there are thousands of verbs in the lexicon of English with a bewilderings variety of sometimes quite complex and idiosyncratic meanings. We must revise G1 so as to account for this richness. If it is even approximately true that all the verb meanings of the language are built around one of a small number of skeletal VSRs such as those furnished by G1, where is the richness of the lexicon to be introduced as flesh on these bones ? A preliminary exploration of the vocabulary suggests a few answers. Verbs of putting (VOP) are those verbs of English which entail a sentence of the form

(50) NP_1 caused NP_2 to be in/at/on, etc. NP_3.

when they are in the appropriate frame. Thus the sentences of (51) entail the corresponding ones of (52)

(51) (a) Blake put the snake in the box.
(b) Jock pocketed the clock.
(c) Hilary banks her salary.
(d) Lulu bit a Zulu.
(e) Fran festooned Dan.
(f) Mike unhorsed Ike.

(52) (a) Blake caused the snake to be in the box.
(b) Jock caused the clock to be in his pocket.
(c) Hilary causes her salary to be in some bank.
(d) Lulu caused her teeth to be somewhere in a Zulu.
(e) Fran caused festoons to be on Dan.
(f) Mike caused Ike to be elsewhere than on a horse.

There are hundreds of VOP in English, and, as the above examples show, one of they ways they can differ from each other is that either the nature of NP_2 or NP_3 is further specified : to pocket something is to put it in a pocket, not a suitcase or your mouth or the bank, to festoon something is to put festoons on it, not your false teeth or chipmunks or a bandage, unless these are functioning as festoons. The conclusion is that we must allow A to be filled by further specifications of a nominal type, as well as by VSR, as we already did to some extent in the G of section 4. That G did not, however, provide the objects that would seem appropriate here. Assuming that CHANGE will be inserted appropriately, what would seem to be needed are SRs like those in (53) :

(53) (a) SR(put) : x CAUSE (y BE LOC z)
(b) SR(pocket) : x CAUSE (y BE IN POCKET)
(c) SR(bank) : x CAUSE (y BE IN BANK)

(d) (bite) : x CAUSE (« TEETH » BE IN z)
(e) SR (festoon) : x CAUSE (FESTOON BE ON z)
(f) SR (unhorse) : x CAUSE (y NOT BE ON HORSE)

It might be asked whether the prepositional element is not sometimes redundant, since a verb meaning such as would be appropriately represented by « x CAUSE (y BE POCKET) » seems implausible. That is, there is no verb meaning to turn something into a pocket, nor does such a verb seem plausible. The suggestion would be that « to pocket » be assigned the SR « x CAUSE (y BE POCKET) » and a redundancy rule be added to insert a preposition meaning. This would produce a more radical kind of meaning difference between input and output than is the case with RR-CHANGE. One problem would be to specify the environment of this rule. There seem to be some cases of VSRs of the form « x CAUSE (y BE NSR) », thus « to knight » is plausibly « x CAUSE (y BE KNIGHT). The solution to this problem might be to limit the rule to cases where the NSR is that of a noun defined in terms of its function. The function of a pocket is to contain things, and no doubt it is not an accident that the languages that contain a verb derived from a noun meaning « pocket » give that verb the meaning of (53) (b). The question in whether the prediction that this will be the meaning comes from a pragmatic rule or a semantic one. Could there be a verb meaning « to cause to be a pocket » if the need for one arosed ?

One observation relevant to this question is this : when we formulate G so as to generate VSRs of the form of (53) (a), and add, as we must, the stipulation that A can be rewritten as NSR, then G will generate SRs like (53) (b) unless we add a filter to exclude them. Thus the proposal that a redundancy rule inserting a PSR (prepositional semantic representation) be adopted entails the proposal that a filter be added to the grammar blocking the generation of precisely those VSRs that the redundancy rule will produce : there is no economy, since the filter and the rule cancel each other out. This situation is to be distinguished from that where a redundancy rule can be used to account for a meaning elaboration of a specific restricted type and at the same time enable us to simplify the grammar. In the latter case the RR will act as supplement to G, rather than being at odds with it.

We can note further that the exclusion of « x CAUSE (y BE POCKET) » may well be a case of a more general exclusion, there are no VSRs of the form « x BE POCKET », « x HAVE APPLE », etc.

The forms of (53) suggest a redundancy rule of a different type, and what appears to be a more legitimate one. The « LOC » of (53) (a) is meant to stand for the maximally unspecified PSR for prepositions of location. We must indicate that any locational preposition may occur with the NP associated with A3 of « put ». We can put a thing in, on, under, near, next to, around, etc., another. With other verbs the range of prepositional meaning is much more restricted. To pocket something, for instance, is to put it in a pocket, not near or below one. However a verb meaning « to put something behind a pocket » is quite implausible. Once again, the nature of the preposition seems predictable from the function of a pocket, a pocket is something you put things in. The situation this time could be different from that for the earlier proposal. Conceivably, by adopting a RR which adds a prepositional meaning to a bare PSR when that meaning is indicated in the NSR following the PSR, we might be able to simplify G by not allowing it to generate VSRs containing fully specified PSRs. On this proposal, the SR of « to pocket » would be « x CAUSE (y BE PREP POCKET) », with PREP standing for a maximally unspecified preposition, and with the A3 « POCKET » having a SR containing a function specification. The SR of the noun « pocket » might be something like « x SUCH THAT... FUNCTION : y PUT z IN x ». The redundancy rule would copy the SR « IN » in the place of PREP.

One possible objection to this proposal does not seem very serious. The SR of « put » must contain the specification that the PREP before A3 is a preposition of location, so that non-locational prepositions such as « about », « of », etc. will not be compatible with « put ». Thus we must allow G to generate at least that much information inside the PSR of a VSR. The proposal would thus have to be modified to say that G generated « x CAUSE (y BE LOC POCKET) » for the verb « pocket ». The RR would fill in the specifications of IN that LOC does not already contain.

A more telling objection is that we do find cases of F-simple verbs whose VSRs do not seem to contain a NSR, and which yet have a more restricted prepositional sense than can be represented by LOC. Consider « wind » as used in

(54) John wound the towel around Zeke's throat.

Note that (55) is elliptical :

(55) John wound the towel.

and furthermore, if it can be used at all, it entails that John wound the towel around something. This suggests the SR « x CAUSE (y BE AROUND z) ». The verb « wrap », on one of its uses, also seems to contain AROUND with no NSR. Considerer also the verb « mount » as in

(56) John mounted the horse.

perhaps the appropriate SR for « mount » here would be « x CAUSE (x BE UP ON y) ».

The examples suggest that VSRs are possible with quite specific PSRs. In fact, we were oversimplifying when we said that « put » could be assigned the PSR « LOC ». The VOP seem to offer a range of possibilities with respect to the specificness of the prepositional meaning they incorporate. Compare the relative acceptability of a range of locational prepositions with a set of VOP which seem to have variables at A1, A2 and A3 :

(i) put : on, in under, over, through, next to, *from, *out of, *at, *towards

slip : on, in, under, over, through, next to, from, out of, *at, *towards
place : on, in, under, over, ?through, next to, *from, *out of, at, *towards
throw : on, in, under, over, through, next to, from, out of, at, towards

If such facts are to predicted from the meanings of the verbs and prepositions involved then either we must find some other characteristic of the VSR of each verb to which its particular co-occurrence behavior can be attributed, or else we must assign each a distinct PSR.

We tentatively conclude that even this second proposal must be rejected. Again, we might suspect that the undoubted difference between the naturalness of a verb meaning « put in a pocket » and one meaning « put next to a pocket » has a pragmatic rather than a purely semantic explanation, but clearly much further investigation of verbs with incorporated prepositional meanings is needed.

Verbs like « bank », « pocket », « bury », « jail », etc., motivate VSRs with a specified NSR in A3 position, after a PSR. Verbs like « bite », « paint », « clothe », « kiss », etc., motivate VSRs with a specified NSR in A2 position, before « BE PSR ». A verb like « pay » might motivate the VSR « x CAUSE (y HAVE MONEY) », a verb like « rain » the SR « RAIN BE DOWN » (i.e. RAIN FALL). The simplest extension of G1 would simply add NSR to the list of ways A could be rewritten.

On similar grounds, the many verbs expressing changes of state, where the resulting state is well described by some occurring adjective, motivate the rewriting of Aas ADJ-SR. The sentences of (57) entail, and are nearly synonymous with, the corresponding sentences of (58) :

(57) (a) The screen reddened.
(b) The sock shrunk.
(c) The result saddened Orpheus.
(d) The price of booze fell.

(58) (a) The screen became red(der).
(b) The sock became smaller.
(c) The result caused Orpheus to become sad(der).
(d) The price of booze got lower.

It will be recalled that a redundancy rule, RR-CHANGE, was postulated to account for the absence in English of a contrast between verbs with the meaning « x BE ADJ » and those with the meaning « x CHANGE (x BE ADJ) ». Assuming that the element MORE can also be accounted for by a redundancy rule, we might represent the meanings of these verbs as in (59) :

(59) (a) x BE RED
(b) x BE SMALL
(c) x CAUSE (y BE SAD)
(d) x BE LOW

We are thus led to revise G1 so as to allow for the development of A as a constant, either (a) in any position, a NSR, or (b) as right-A of BE,

an ADJ-SR. We can at the same time allow for SRs like those of (53) by revising R2 of G1 to :

R2' : $A \rightarrow \begin{cases} VSR \\ NSR \\ ADJ\text{-}SR \\ PSR\ NSR \end{cases}$

However we must add an indication that BE is the only V-PRIME which can take ADJ-SR, and that only as right-A. The same seems to be true for the sequence PSR NSR, and we can express this similarity between ADJ-SR and PSR NSR by a further slight revision, as in G2 :

G2 : R1. $VSR \rightarrow A\ V\text{-}PRIME\ A$

R2. $A \rightarrow \begin{cases} VSR \\ NSR \\ ASR \end{cases}$ R3. $ASR \rightarrow \begin{cases} ADJ\text{-}SR \\ PSR\ NSR \end{cases}$

With G must be associated a lexicon of V-PRIMEs, properly restricted. For the V-PRIMEs BE, HAVE, CAUSE, and in fact for any plausible candidates for relational V-PRIMEs, it seems to be the case that the only possible left-A is NSR, including the case where NSR is not further deeloped, i.e., is a variable. Furthermore, for the V-PRIMEs mentioned, each allows a distinct set of possible right-A's, something which might suggest to a Hjelmslevian that the semantic primitives could be defined in terms of their co-occurrence possibilities. To characterize these possibilities in terms of the nearest real verbs we can find to pure expressions of our V-PRIMEs, anything can *be* anywhere or *be* Adj, i.e. have a property expressed by an adjective ; perhaps only entities (ENT), that is, objects, persons, etc., but not events, facts, etc., can *have* entities, properties, but not facts, events, etc. ; anything can be a causer, but only an EST (event or state) can be a causee. This is still rather rough and vague, but we can give a preliminary formulation to these limitations as in (60) :

(60) CAUSE : right-A = VSR
BE right-A = NSR, ASR
HAVE right-A = NSR

To express the regularity that all left-A's are NSRs, weadd F2 to F1 :

F1 : eliminate any VSR which has a depth of embedding of more than three V-PRIMEs
F2 : eliminate any VSR in which a relational V-PRIME has a left-A distinct from NSR

We have thus revised (49) in two ways : by making the left-A restriction general, and by identifying EST with VSR. The latter move raises a problem. It is apparently the case that « CAUSE » in VSRs always has as right-A a VSR, and seemingly always one that itself contains a variable. If so, then

« to cause an earthquake » is not a possible verb meaning in English. However the *verb* « cause », to which we have assigned the SR « x CAUSE y », allows both EST NPs and « to verb... » sequences as complements. This observation of itself does not falsify the claim we would like to make that the co-occurrence behavior of a verb can be predicted from the co-occurrence behavior of its V-PRIMEs : we have not claimed that the rules are trivially simple. Their formulation raises some interesting and complex questions, discussed in Carter (to appear). The difference between « CAUSE » and « cause » reflects a general trend for restrictions to be tighter within the VSR than across word boundaries. Another example of this is the much-discussed difference betwen « kill » and « cause to die » (see, e.g. Fodor (1970)). Another case is exemplified in (60) : we have given NSR and ASR as possible right-A's of « BE », but not VSR, since VSRs like « x BE (y V-PRIME z) » seem not to exist. However we do find that the *verb* « be » can be followed by NPs like « the earthquake », « that event ». On the other hand, if we allowed « BE » to be followed by VSR we would be faced not only with the problem or ruling out non-existent VSRs but also of explaining why « *John was Bill to leave » does not exist while « John caused Bill to leave » does. The problem is that when we say in the lexicon that « BE » does not allow VSR as right-A we seem to predict that such perfectly acceptable sentences as « The most important thing that ever happened there was the earthquake » could not occur.

Perhaps the solution lies along these lines : the requirements that « CAUSE », « BE », etc., place on their right-A's and other arguments are to be interpreted differently in VSRs and across word boundaries. Across word boundaries the material to be associated with, for instance, the right-A of « CAUSE » must constitue a VSR, that is, a structure generated by G, but that material may take different forms. One form it may take is that of an NP where the SR of the head noun contains the VSR in the appropriate way. This must be formulated so that « earthquake » has an appropriate NSR while « pocket » (which also seems to have to contain a VSR, but perhaps in a more subordinate position) does not. This is the problem of how NSRs of event nouns differ from NSRs of thing nouns, etc. Another form the material to be linked to the right-A of CAUSE may take is the sequence « NP to Verb... ». We must still for the present adopt some device to present BE from being followed by VSR in a VSR and from being linked to « NP to Verb... » in a sentence, while allowing it to be linked to « earthquake » etc. in the sentence but not in the VSR. If we mark BE in the lexicon of V-PRIMEs as excluding VSR as right-A we will have the first two goals. In order to still allow the linking of BE to « earthquake » we can say that the internal structure of a NSR is such that it allows linking of a noun like « earthquake » containing VSR even to a V-PRIME excluding VSR as a right-A, but does not allow linking of a noun not containing VSR to a V-PRIME requiring VSR as right-A.

8. As it stands, G2 specifies a large, possibly infinite, number of VSRs. Its scope depends on the allowed developments of NSR, ADJ-SR, and PSR. To claim that G2 was an accurate description of the class of possible verb meanings would be to claim that all meaning complexity could be assigned to the slots associated with left and right. A's. There exists, however, a large class of meaning elaborations which do not seem to conform to this pattern. Considering again the VOP, we find that there are many verbs of more specific meaning than « put », which is perhaps closest to a « pro-VOP ». These verbs are like « put », and unlike such verbs as « paint », « bite », « bank », « stab », « bag », etc., which motivate analyses in which either A2 or A3 is filled by a specified NSR, in that they, like « put », require the presence of three NPs, one of which is in a PP, for a non-elliptical sentence.

In our framework this fact in itself suggests that such verbs have variables, and not specified NSRs, in all three positions. If one empirical requirement on a theory of meaning is that it provide representations and an appropriate mechanism for relating syntactic behavior to meaning, then it would be an elegant solution to the problem of predicting whether a verb is transitive, intransitive, requires a PP, etc., if we could show that this could be predicted from an independently motivated SR for each verb. One quite simple rule would be this : a verb will require a given complement : subject, object, indirect or prepositional object, etc., if the A corresponding to that complement position in the VSR is unspecified, i.e., occupied by a variable. The job of determining what A corresponds to what complement position is assigned to the linking rules, discussed in Carter (to appear). If this generalization is essentially correct, then three NP verbs should have three variables in their SRs.

There are many three-variable VOP where the manner of putting or causing to be seems to be part of the meaning, such verbs as « throw », « slip », « slide », « roll », « ease », « shove », « force », « pour », etc.

That such verbs are VOP is indicated by the fact that the sentences of (61) entail those of (62) :

(61) (a) Lupin slipped/ sneaked/ slid eased his hand into Holmes' pocket.
(b) Holmes forced/shot/tossed/pulled his pipe into Lupin's briefcase.

(62) (a) Lupin put his hand into Holmes' pocket.
(b) Holmes caused his pipe to be in Lupin's briefcase.

Dictionaries typically define these verbs correspondingly. Thus ALD3 defines this sense of « slip » as « put... with a quick, easy movement ». Let us call adverb-like meaning enrichments of this type « satellites ». A glance at a monolingual dictionary of a language will suggest that satellites are an extremely common part of verb meanings, not just for VOP, but for verbs of many kinds.

Thus, to guffaw is to laugh noisily, to snicker is to give a half-suppressed laugh, especially, according to ALD3, at something improper, or in a cynical manner. There are quite a few other verbs in the « laugh » family, differing from « laugh » in having a more specific adverbial-like specification, c.f. chuckle, giggle, titter, cackle, chortle, horselaugh, etc. A large number of other such « families » can be found in the lexicon of English. Thus the « eat » family includes : bolt, browse, devour, gobble, gorge, gulp, guzzle, nosh, wolf. Among the verbs expressing movement with the legs are : walk, run, gallop, skip, hop, saunter, sashay, amble, dance, hobble, limp, trot, mosey, march, tramp, prance, etc.

A systematic attempt to classify the verbs containings satellites according to the type of meaning present will reveal that there are severe restrictions on the variety, nature, and occurrence possibilities of satellites. Thus many are characterizable as adverbs of manner : to babble or prattle is to talk foolishly, to stutter or stammer is to speak haltingly, to guzzle is to eat or drink greedily, to beam is to smile cheerfully. Other verbs seem to involve satellites of frequency : « tickle », « harass », « vibrate » involve repetition. Others involve intensity : tittering and chuckling are ways of laughing softly, to guffaws is to laugh loudly, though that is not the whole story, Presumably it would be redundant to say in the SRs of « titter » and « chuckle » that what is involved is involved is low intensity of *sound*, the basic SR of « laugh » must say something about sound, and it should be predictable from a VSR like « x LAUGH LOW » that the appropriate dimension is the dimension of sound intensity. For verbs not involving sound, or not involving it in the same way, the redundancy rule in question, which I will not here attempt to formulate, would assign the intensity or degree to another dimension. Thus the contrast expressed in the pairs « like » and « love », « walk » and « run », « nibble » and « bite », « trickle » and « flow », « frighten » and « terrify », « sip » and « guzzle », « doze » and « slumber », etc. would involve other parameters. That there may be such a rule is supported by the observation that verb meanings like « trickle of flow noisily », « walk noisily », etc., do not occur and are rather implausible. We seem to find satellites of intention or purpose : « assassinate », « diet » ; of means : « suffocate », « drown », « polish » ; of speed : « drawl », « chatter ».

Many combinations of the adverbial meanings so far mentioned with verbs seem implausible as lexicalizations, although as separate words the combinations make perfect sense : to bite someone for political reasons (c.f. « assassinate ») ; to walk in order to lose weight (c.f. « diet ») ; to frighten by rubbing repeatedly (c.f. « polish »). Perhaps some or all of these non-existing combinations do not occur for pragmatic reasons : we rarely frighten someone by rubbing him or her repeatedly ; one is rarely bitten for political reasons, though from time to time someone is killed. Other exclusions within the VSR parallel exclusions at the sentence level.

The non-existence of verbs meaning « to sleep in order to forget », « to have something noisily », « to contain something clumsily », « to grow (= become bigger) intentionally » is predictable no doubt from the oddness of the sentences « ? John is sleeping in order to forget Olga », « *Vladimir had a beard noisily », « ? Alice is growing intentionally », etc. A semantic theory is of course responsible for predicting that parallel.

It is conceivable that other non-occurring combinations are predictable on other grounds. One principle that suggests itself is : only adverbials of semantic types for which verbs subcategorize are possible satellites. This would account for the absence of verbs meaning « to sleep/kill etc. in England/the bathtub, etc. », « to eat/ laugh etc. at noon/ on Thursdays, etc. » Note that « He breakfasts at six p.m., dines at four a.m., and sups at noon » is the appropriate way to describe someone with those unconventional eating habits, and this seems to indicate that a time specification is not part of the meaning of « to breakfast », etc.

There is obviously much more to be said about this rich and, as far as I can tell, almost totally unexplored area of verb semantics. For the present, let us tentatively incorporate ADV-SR (adverb SR) into G as a sister to « A V-PRIME A », which we can call the nucleus. However, there is no more reason to add the rule « VSR → NUC (SAT) » to G than to have a rule in the base component of a grammar along the lines of Chomsky (1965) which introduces the terms « subject » and « predicate ». We rather use these as terms for talking about theoretically significant parts of the structures the grammar produces. Thus the nucleus is the sequence « A V-PRIME A », the satellite is the sequence ADV-SR, which is sister to the nucleus, just as a variable for us is an A which does not dominate further material. We thus revise G2 to G3 :

G3 : R1. VSR → A V-PRIME A (ADV-SR)

R2. A → { VSR, NSR, ASR }

R3. ASR → { ADJ-SR, PSR NSR }

It will no doubt be apparent to the reader that G3, associated with the filters so far discussed, while coming a step closer to adequacy as a description of verb semantic structure, is far from satisfactory. In the first place, it still fails to provide VSRs for certain occurring meanings, for instance those involving such operators as negation and modality. On the other hand, it overgenerates, providing many highly implausible VSRs. Let us examine each of these defects in turn.

9. It is hard to doubt that there are verbs which contain a negative element of meaning. Thus the sentences of (63) entail their parallels in (64) :

(63) (a) Jacques lacks enough money.
(b) Cynthia deprived Leonardo of his fish.

(c) Ray denies that he is wrong.
(d) Clancy stripped.
(e) They castrated Orpheus.

(64) (a) Jacques does not have enough money.
(b) Cynthia caused Leonardo not to have some fish.
(c) Ray claims/says that he is not wrong.
(d) Clancy caused his clothes not to be on him.
(e) They caused Orpheus not to have his sexual organs.

Similarly, there are verbs for which it is reasonable to propose a modal component of meaning. The sentences of (65) entail their counterparts in (66) :

(65) (a) Aline can sing like a bird.
(b) The count promised to return to Transylvania.
(c) The crutches enabled John to hobble home.
(d) We ordered Kevin to return the raven.
(e) Beckmesser goofed.

(66) (a) Aline is able to sing like a bird.
(b) The count caused there to be an obligation for him to return to Transylvania by saying something.
(c) The crutches caused it to be possible for John to habble home.
(d) We created a verbal obligation for Kevin to return the raven.
(e) Beckmesser did something he shouldn't have done.

These facts suggest a further enrichment of G by allowing it to introduce negative and modal elements. The questions then arise of how many distinct elements are necessary and where they are to be allowed to occur. Their possibilities of concurrence and their variety seem to be rather restricted. Representing the negation element as « NOT », it would be reasonable to treat « lack » as the negative counterpart of « have », by giving it the SR « x NOT HAVE y » or « (x HAVE y) NOT », with any unpredictable meaning differences between « lack » and « have » to be accounted for by additional meaning specification of either or both verbs. Similarly, if the SR of « receive » is something like « x CHANGE (x HAVE y) » then the negative version of that would be « x CHANGE ((x HAVE y) NOT) » which might be appropriate as SR for the verb « lose », or, with a higher NOT, « (x CHANGE (x HAVE y)) NOT », which might be correct for one sense of « kee », that in « Jake kept the cake », on the non-causative reading. This proposal would allow us to dispense with a primitive durative element (such as the « STAY » in Jackendoff, 1975), analyzing all durative verbs in terms of « NOT » plus « CHANGE ».

If the SR of « give » is « x CAUSE (y HAVE z) » then by inserting « NOT » in the lower or in the higher predicate we obtain either « x CAUSE ((y HAVE z) NOT) » or « (x CAUSE (y HAVE z)) NOT ». The first is a reasonable candidate, with suitable further specification, for the SR of verbs like « deprive », « rob », « take », « steal ». For the second SR, however, I find no suitable verbs. Many additional VSRs with a « NOT » associated with « CAUSE » rather than with the V-PRIME below « CAUSE » also seem implausible. Consider, for instance, « (x CAUSE (y BE DEAD)) NOT », « (x CAUSE (y BE RED)) NOT », « (x CAUSE (y BE IN BANK)) NOT ». We note that « to remove y from z » means roughly « to cause y not to be in z » and not « not to cause y to be in z », and that there appears to be no verb with anything like the latter meaning. Likewise, « to unearth treasure » is roughly « to cause it not to be in the earth », not « not to cause... » etc. Perhaps it is not too strong a constraint to simply say that « NOT » can never be so associated with « CAUSE ». For the causative sense of « Jake kept the cake » we propose « x CAUSE ((x CHANGE (x HAVE y)) NOT) » ; for the « refrain » in « Payne refrained from complaining » the SR may be essentially « x CAUSE ((x CAUSE y) NOT) », where the lower « CAUSE » would be equivalent to « DO », that is, would be associable with a verb such as « complain » which also contains « CAUSE », the rules governing that association operating in such a way that the two « CAUSEs » only count as one. If this analysis were correct, then « refrain » would be a verb with two occurrences of « CAUSE ».

We mention in passing a further limitation on the occurrence of « NOT ». If to lack is not to have, and to lose is to come to not have, why couldn't there be a verb meaning « not to come to not have » ? I have so far found no such verb. It would presumably have the VSR « (x CHANGE ((x HATE y) NOT) NOT) », but by the proposal that duration be represented with « NOT » and « CHANGE » a verb with that SR should mean « to continue to not have ». This would be a verb « freep » such that, as « This passage keeps/retains its beauty when translated into Xhosa » entails « This passage continues to have its beauty when translated into Xhosa », so « This passage freeps lucidity when translated into Banana » would entail « This continues to lack lucidity when translated into Banana ». It would be nice to be able to claim that the reason why a verb meaning « not to come not to have » does not exist is because it could not, due to the durative proposal, which would turn it into « freep », but « freep » seems not to exist either in the languages I know. Unless further research turns up counterexamples, this suggests a more general explanation for the lack of either type of verb : perhaps VSRs with two idiosyncratic « NOTs » are excluded in most cases or even in general.

Let us now turn briefly to modal elements. A reasonable proposal is that we allow G to introduce, in addition to the negative « NOT » the two modal elements « OBL » and « POSS ». Suppose we enter these elements in our lexicon of primitives as one-A V-PRIMEs, allowing that A to be developed as VSR, but not NSR, ADJ-SR, etc. In our « grammar » of VSRs all the rewrite rules are optional, so G would generate « x OBL », « x POSS », where x would be dominated by the node VSR, that is, where VSR had not been developed further. It would be reasonable to assign the

former VSR to « must », the latter to « can », with perhaps further material to distinguish « must » from « ought », « can » from « may ». G would also produce « x NOT », which does not correspond to any verb of English, or most other languages. If there are languages where « not » is a verb, and if these are statistically uncommon, then presumably « not » is less normal, more marked, as a verb than other verbs whose SR is essentially one of the V-PRIMEs. There seem to be, for each of our V-PRIMEs, a certain number of languages which do not lexicalize it as a bare verb, but rather either along with other V-PRIMES in VSRs, or as an affix or other non-verbal morpheme. This raises the possibility, which I cannot pursue here, that there might be such a cross-linguistic characterization of the theoretical entity V-PRIME, perhaps a statistical one. It would also be interesting to have a theory of markedness that predicted that verbs like « x NOT » would be less likely than verbs like « x OBL », if they are, etc.

Most of the VSRs generated by this revision of G are non-existent and implausible, at least as formally simple verbs, c.f., for instance : (x BE RED) POSS ; (x BE ALIVE) OBL ; (x BE SMALL) NOT ; x CAUSE ((y BE RED) OBL) ; x CAUSE ((PAINT BE ON z) POSS. If a verb had the SR » (x CAUSE y) OBL » then it would presumably be a « twimble » such that « John twimbled the accident » vould entail something like « John was forced/obliged/ had to cause the acident ». Conceivably « (x HAVE y) OBL » could serve as SR for « need » or « require », in sentences like « John needs the book », and this would force us to assign « need » a different SR for « John needs to go ».

I have found these verbs so far for which SRs of the form « (x V-PRIME y) OP » are at least plausible, where « OP » stands for « OBL », « POSS », or « NOT » : « (x HAVE y) OBL » is perhaps essentially right for « need », « require » ; « (x HAVE y) NOT » is plausible for « lack » ; if this is so, then wy shouldn't there be a verb for which « (x HAVE y) POSS » is roughly suitable ? If the SR of « contain » is « x BE IN y » then perhaps that of « hold » on a sense is roughly « (x BE IN y) POSS ». Without attempting to analyze further, let us represent « know » as « x KNOW y » ; then for the French verb « ignorer » « (x KNOW y) NOT » would be appropriate. No verb with this sense seems to occur in English. If we represent « believe » as « x BELIEVE y », then if we ask whether there is a verb which « (x BELIEVE y) NOT » might be the central part of the SR of, the verb « doubt » suggest itself, though there is certainly more to the story : doubting is perhaps closer to hesitating to believe. What about « (x BELIEVE y) OBL » and « (x BELIEVE y) POSS » ? The first is not really appropriate for « deduce », which is closer to « believe (or, better, come to believe) that necessarily y » than to « necessarily believe that y » ; the second is not really appropriate for « suspect », which is closer to « feel or believe that possibly y » than to « possibly believe that y ». ALD3 defines « deserve » as « be entitled to... ; merit ». It does not seem far-fetched to consider « deserve », « merit » as close to « ought to have », and to propose the SR « (x HAVE y) OBL » with some further indication to distinguish the kind of obligation expressed by « ought » and « should » from that expressed by « must », and thus « deserve » from « need », perhaps something along the lines of « (x HAVE y) OBL (BECAUSE x CAUSE GOOD) » for « deserve ». With « deserve » the obligation is perhaps merely a moral one : good deeds should be rewarded. « The machine needs oiling » expresses a stronger kind of obligation : if it doesn't get oiled, something bad, i.e. undesired by someone, will happen : it will cease to function correctly.

To end our overly brief survey of VSRs containing a modal element, let us consider the case of VSRs with « CAUSE ». We have seen that many VSRs obtained by inserting « OBL » or « POSS » into the VSR of some occurring verb are implausible, but some are more reasonable. Thus, if « give » has the SR « x CAUSE (y HAVE z) », what verb might « x CAUSE ((y HAVE z) POSS » work for ? Conceivably « offer », if it is reasonable to say that to offer somebody something is to make it possible for him to have it. I find, however, no candidates for the VSRs : x CAUSE ((y HAVE z) OBL) ; x CAUSE ((y BE (PSR) z) POSS ; x CAUSE ((y BE (PSR) z) OBL). Conceivably « condemn » could have the VSR « x CAUSE ((y BE DEAD) OBL) », but then why do we feel that it is not redundant to say « They condemned him to death » ? There seems to be no verb for « x CAUSE ((y BE DEAD) POSS) ». I find no modal versions for the « make » of « She made him happy/ an admiral » either.

The general picture thus seems to be, for this area of meaning, that verbs for which it is even plausible to propose a VSR containing a modal element are few and somewhat randomly distributed. This observation itself tends to call into question the proposal that there are modal primitives : we have seen that for the alleged primitives « CAUSE », « BE », and even, to a lesser extent, « HAVE », « NOT », there are many verbs which, plausibly, include them. An alternative proposal would be that « POSS » and « OBL » are not primitives, but rather complexes, perhaps more appropriately represented as ADJ-SRs than as V-PRIMEs. Such a proposal would imply that their position and frequency in VSRs were different. There is one rather large class of verbs, however, where, though the proposal that they contain a modal is disputable, it would permit a uniform description of that class and increase the number of verbs with modals. This is the class of performative verbs.

If we characterize performative verbs as those verbs which express acts that are accomplished by saying something, acts done with words, which we can tentatively represent as verbs whose VSRs contain the satellite « BY x SAY y », with the reasonable expectation that redundancy statements can associate x and y with constituents in the nucleus, and that further analysis will be given to « SAY », then the question arises :

for each verb in this class, what is it that is done. For « promise », dictionaries speak of giving one's word, or undertaking to do something, and they relate it to words like « engage », « covenant », « contract ». It seems in fact a reasonable proposal that the act of promising is the creating of an engagement or obligation to do something by uttering the appropriate words. We can represent this tentatively as « x CAUSE ((x CAUSE y) OBL) (BY x SAY w) » where w will be related to the subconstituent « x CAUSE y ». In words this would read « x causes x to be obligated to do y by saying x (will) do y ». Taking this, or something like it, as a representative of the normal form for one sub-class of performative verbs, we can try ringing the changes on it to see if any alternations yield plausible VSRs. Thus « x CAUSE ((y CAUSE z) OBL) (BY x SAY w) » seems to fit « commit » as in « John committed Nana to doing the dirty work », however, this VSR is also not totally far-fetched for verbs like « order », « request », « ask », etc., which also seem to involve the setting up of verbal obligations.

A word about « CHANGE ». So far we have been considering it as a two argument primitive introduced by redundancy rule. However, not all occurrences of « CHANGE » in VSRs are predictable. We find such minimal pairs as « have », perhaps « x HAVE y », and « receive », perhaps « x CHANGE (x HAVE y) », « know » and « learn », « be » and « become ». There seems to be no reasonable alternative to adding « CHANGE » to our list of primitives. It is also plausible to treat it as a one-place primitive, which would eliminate having to say for « CHANGE » that it requires that its left-A must be identical to the left-A of the V-PRIME embedded as its right-A. Furthermore, there seems to be no point to allowing « CHANGE » to have « CAUSE » as V-PRIME of A, and if we grouped it with « NOT », « OBL », and « POSS », this would permit the generalization : no one-A primitives embed « CAUSE ». This would force us to modify the VSR proposed for « promise », which is problematic for another reason, namely the fact that the lower « CAUSE » is often if not always redundant in the sentence. Introducing « CHANGE » into the lexicon of primitives would however create a problem for the formulation of RR-CHANGE we proposed earlier, since the simplest G would generate such structures as « (x BE RED) CHANGE » directly, so that there would be no point to introducing them by a redundancy rule that inserted semantic material. The redundancy could be reformulated as a filter which ruled out such VSRs as « x BE RED » directly.

10. We mentioned that there were two problems with G3, first its poverty, which we have alleviated by adding one-A primitives to our lexicon, and second its overrichness, which we have aggravated by adding one-A primitives. This addition requires the modification of R1 of G3 to R1' :

R1' VSR → A V-PRIME (A) (ADV-SR)

Let us call the grammar produced by this modification G4. G4 produces too many VSRs for which no verb senses can be found, and in many cases these gaps seem not to be accidental. Let us consider this problem further.

There is no reason I know of why it should always be immediately determinable whether the lack of a given verb meaning in a given language is accidental or systematic, but there seem to be clear cases at either extreme. Thus, having found that in English there are verbs of change of color (VCC) associated with the colors red, white, black, yellow, brown, tan, purple, we can suspect that the absence of a verb meaning « to turn orange » is basically non-significant for semantic theory, though there might be a historical explanation for this gap, which is not restricted to English.

At the other extreme, we suspect that the absence of a verb meaning « to turn from yellow to red » is not an accidental gap, to be explained, if at all from historical or pragmatic considerations. It would in fact be of some use to have a verb expressing this change, which occurs once every minute or two at many heavily trafficked intersections in parts of the English-speaking world. The exclusion is apparently much more general since, as noted in section 3, for most domains, such overly specific verb meanings are excluded. G4 as now formulated excludes all such cases (including the few motivated ones) by not providing VSRs of the kind that would be needed.

The problem remains of what to do about cases between these two extremes. The following rule of thumb seems helpful : let the semantic theory decide whether a gap in the lexicon is accidental or not, by trying to construct a G such that, while it provides a SR for every sense to be found in the lexicon of the language, it provides as restricted as possible a set of SRs which cannot be assigned to any actually occurring item of the language. The degree of interest of any exclusion we make will be inversely proportional to the specificity of the statement that has to be added to G to make that exclusion. The least interesting exclusions, those that cannot be made by some general formulation, we can call accidental gaps in the lexicon.

For instance, to allow the VSR « (x BE RED) CHANGE » while excluding « (x BE ORANGE) CHANGE » if it were necessary to add a filter mentioning « ORANGE » explicitly, say « eliminate any VSR containing ORANGE », that filter would do very little work. On the other hand, for Dutch, which, I am told, has no color verbs at all, the much more general filter « eliminate any VSR containing ADJ-SR_i, where ADJ-SR_i is an adjective of color meaning » could be formulated. It would not be useful to say that by « general filter » we mean one which does not contain specific semantic material, since for instance filters formulated in terms of specific V-PRIMEs will be quite interesting for semantic theory. Thus it would be important to know if there were any languages that

systematically excluded VSRs containing « CAUSE », or « CHANGE », or « NOT », or some other primitive element. As far as I know, nobody has ever asked such questions systematically, but conceivably the answers could be highly interesting. If languages turn out to have systematic gaps in certain areas of meaning, semantic theory ought to account for the ones found, for their variety and relative frequency. Thus facts about systematic gaps might create interesting criteria for choosing among semantic theories on the basis of their sets of primitives, the descriptive mechanisms they make available, i.e. their counterparts to the « grammar » of VSRs, etc., and their compatibility with an empirically adequate theory of markedness.

We will thus be led to ask, when we observe that a particular version of G generates a non-occuring SR_i, how G would have to be changed so as not to generate SR_i. In some cases we will be able to simplify G, or to reformulate it without increasing its total complexity. In other cases we will have to complicate G, perhaps by adding a filter, or by further specification in our lexicon of primitives. Our view of G is that it is a tool to help us find interesting questions to ask, and so we will want to know how much work the complication does — how large a class of non-occurring forms it excludes, how it fits into a general theory of lexical possibility, and what it might tell us about the human conceptual system.

Let us examine briefly a few more ways in which G4 overgenerates. Among the non-occurring structures allowed are these :

(67) (a) BOY CAUSE (DOG BE UNDER BED)
(b) MEASLES BE y
(c) (BOOK BE RED) CHANGE
(d) BABY HAVE y
(e) WATER CAUSE y

No doubt the total implausibility of (a) could be attributed to its extreme explicitness : we do not have many occasions to use a verb that could only be used of a boy to denote his putting some dog under some bed. The exclusion is however deeper than that : there are few plausible exemples of verbs whose A1, the argument-place that will be associated with the deep subject in an Aspects-type grammar, is specific enough to warrant its being represented by a NSR. If there were a general restriction against such verbs, which we could formulate as F3 :

F3 : eliminate any VSR in which there is an A1 which is not a variable

then the most serious counterexamples would be the weather verbs. It is plausible, for instance, to represent « to rain » with something like « (RAIN BE DOWN) CHANGE », with a SR parallel to that for « to fall », in order to account for the entailment from (68) to (69) :

(63) It is raining.
(69) (a) Rain is falling.

(b) Rain is changing from being up to being down.

Hopefully some explanation could be found for this odd set of exceptions to the overwhelming regularity expressed in F3.

What would not be counterexamples to F3 would be cases of verbs like « die » which were claimed to be restricted to living subjects, for such restrictions are predictable from their meaning. For instance « die » contains in its SR the semantic material associated with « alive » and « living » and so the claim that « die » is restricted to living subjects would reduce to the true but trivial statement that a verb can be appropriately predicated of only those things of which it can appropriately be predicated. There is no need for the grammar to rule out a string like « Sincerity died » at all. Either it is predictable from the meaning of « sincerity » that it cannot be alive, so that general principles for determining contradictory strings would mark this string as contradictory, or else it is not predictable, but is rather something we know about the world, in which case the grammar is not the appropriate place to indicate that information, for those who accept the division between encyclopedia and dictionary. More problematic cases for F3 would be cases of restrictions placed by verbs on their subjects that could not reasonably be attributed to the meaning of the verb. For instance, if a language had two verbs meaning « to eat », one of which could only be used for animals, the other for humans, and it was not the case that the difference could be attributed to a difference in the manner of eating, i.e. to a satellite, then this would force us to modify F3 so as to allow A1 to dominate certain kinds of semantic material.

In any event, F3 as it stands rules out the VSRs of (67). We note in passing that it would be wrong to alter F3 to accomodate weather verbs by simply adding « except when A1 is a weather NSR » since that would allow the implausible « RAIN CAUSE y », « RAIN CAUSE (y BE z) », etc.

It seems clear that restrictions are tighter on A1 than on other A's, but there seem to be more general restrictions on what kind of NSR an A can be developed as. Consider the VSRs of (70) :

(70) (a) x HAVE MEASLES
(b) x HAVE HEADACHE
(c) (x BE UNDER BED) CHANGE

(b) seems closer to plausibility than (a), but there seem to be no VSRs of the form «x HAVE NSR ». This gap is perhaps to be associated with the absence of VSRs of the form « x BE ADJ-SR » and « x BE PSR NSR » — there are in fact very few one-A stative verbs in English. If, simplifying things a bit, we say that stative verbs are verbs with VSRs that do not contain « CHANGE » (assuming that RR-CHANGE will still operate to insert « CHANGE » under « CAUSE »), that is, given our assumptions, that statives are verbs that have only one V-PRIME, then the restrictions might be stated as in F4 :

F4 : eliminate any VSR with only one V-PRIME which does not contain two variables

Exceptions to F4 are VSRs with just one one-A V-PRIME such as modals : « must », « ought », « can », « may », etc. This could lead us to deny that modals are verbs, even that « OBL », etc. are V-PRIMEe. Interestingly enough, however, modals also require two elements in the sentence, e.g. « John » and « be sad » in « John must be sad », even though, on the analysis adopted here, they have only one A in their VSR. This might suggest that the restriction expressed in F4 is a consequence of a general restriction governing the relations between form and content in English which cannot be revealingly treated as a restriction on possible verbs. However an attempt to deal with these facts syntactically must face the problem of why « x BE RED » etc., are excluded while « (x BE RED) CHANGE » etc., are perfectly normal, that is, why one-A statives are in general excluded while one-A non-statives are allowed. A further problem is posed by the few cases of absolutely intransitive statives, verbs like « exist », « stink » and « smell ».

The characterization of stative verbs as verbs with one-V-PRIME VSRs suggests a characterization of non-stative, i.e. event, verbs as verbs with VSRs containing CHANGE. There would then be no need to include in the VSR of each event verb in the lexicon an A for the element « EVENT » to account for the entailments from (a) to (b) in (71) and (72) :

(71) (a) John got an apple.
(b) There was an event.

(72) (a) John flew to the north pole last year.
(b) Something happened last year.

Nor is it obvious that some redundancy rule would be needed to insert an extra argument place whenever the VSR contained « CHANGE ». Conceivably we could formulate entailment rules and the SRs of « event », « happen », etc., so as to account for the relevant entailments without ever having to say that « get », « fly » etc., contain an extra argument place (see Davidson, 1967, Fodor, 1972).

It might be mentioned here that we are led to revise the characterization of « inherent argument » given at the beginning of this paper. Since all real verbs (.i.e., excluding modals) are built out of V-PRIMEs that have two argument places any verb must have at least two A's. Thus there will be no one-A verbs, and the verbs we called verbs with one IA are merely verbs where all A's but one are filled by constants. Our classification of verbs can be revised in terms of the number of variables, that is, of unfilled A's. There exist verbs with no variables : « rain », « snow » ; with one : « die », « fall » ; with two : « contain », « kill » ; with three : « put », « give » ; and with four : « trade », « exchange ». F1 still excludes VSRs with more than four A's, and thus verbs with more than four variables.

Our grammar of VSRs still produces structures which are implausible : compare (73) (a) and (b) :

(73) (a) x CAUSE (y HAVE DOG)
(b) x CAUSE (y HAVE MONEY)

While there is no verb for which (a) would be even roughly appropriate and in fact (a) seems rather implausible as the VSR of a formally simple verb, (b) is not bad as a candidate for the VSR of « pay ». The difference between (a) and (b) is that « DOG » is a more concrete kind of meaning than « MONEY ». Other facts suggest a restriction on NSRs within VSRs to those of less specific character than many occurring nouns. Thus to bite is not really to put one's teeth somewhere, « teeth » is too specific, since we can use « bite » of ducks, mosquitos, and other creatures which have no teeth. What is needed is something closer to « the cutting edge of one's mouth », a concept to which no English noun corresponds. It is important here to distinguish between verbs derived from nouns and those which do not formally ressemble nouns not derived from them. Thus compare « knife » and « stab ». The former, derived from the noun « knife », has a much more specific meaning than the latter, as the oddness of « John knifed Bill with an icicle » shows alongside the normal « John stabbed Bill with an icicle ». Perhaps we can predict that a verb with the VSR « x CAUSE (y BE KNIGHT) » would have to be formally derived from a noun. The occurrence of « to knight » and the non-occurrence of « to endog », meaning to turn into a dog, would be explained by the relatively greater difficulty of turning someone or something into a dog than into a knight, i.e., pragmatically. Ignorance about the structure and properties of NSRs prevents me from giving a useful formulation to this restriction, but i would appropriately predict that structures like (67) (a) are triply impossible.

11. It is clear that our « grammar » is still inadequate in many respects. For one thing, it does not account for the « presuppositions » associated with verbs. For some of the cases discussed in the literature, this is not a drawback, since the phenomena involved are predictable by general rule, and thus nothing need be said in the lexical entry of the verb in question. However, there are « idiosyncratic presuppositions » of verbs, for example the meaning of « badness » associated with certain verbs of judging. A natural extension of G4 to account for such would involve the generating of ADJ-SRs as modifiers of A's. This raises interesting problems which would require much more space to discuss.

For another thing, we have not discussed the regularities involved in VSRs containing body-part expressions such as « bite », « kiss », « behead », where the part must belong to the individual associated with the « nearest » A. Nor have we treated VSR-internal coreference, neither in the case of verbs like « suicide », « dress », where two A's in the nucleus must be related, nor in the great regularities holding between nucleus

and satellite. Furthermore, there are many verbs for which it is disputable that G4 provides any plausible representation, for instance such verbs of action as « laugh », « cough », « walk », « roll », etc.

Another thing we have not done is give an adequate defense of the V-PRIMEs we have used : « HAVE » and « BE » are suspiciously complementary in their occurrence possibilities, « OBL » and « CAUSE » seem to be related in some murky fashion, « OBL » can be defined away, perhaps, in terms of « POSS » and « NOT », etc.

There are many other inadequacies that could be mentioned concerning the fragment of a « grammar » of possible verbs presented here, but perhaps the foregoing necessarily incomplete discussions and proposals will be useful in showing that there exists an important and still largely unexplored field of investigation in the data of lexical meaning, one with perhaps vital implications for theories of cognition.

APPENDIX

Final version of G

R1. VSR → A V-PRIME (A) (ADV-SR)

R2. A → { VSR, NSR, ASR }

R3. ASR → { ADJ-SR, PSR NSR }

F1 : eliminate any VSR which has a depth of embedding of more than three V-PRIMEs

F2 : eliminate any VSR in which a two-A V-PRIME has a left-A distinct from NSR

F3 : eliminate any VSR in which there is an A1 which is not a variable

F4 : eliminate any VSR with only one V-PRIME when that VSR does not contain two variables

RR-CHANGE : insert CHANGE immediately under right-A of CAUSE

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Presupposition and implicature

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1. The beliefs that I take to be held by those other speakers of my language with whom I converse play a crucial role in determining what I choose to communicate and how I choose to communicate it. The linguistic acts I perform are in fact premissed on an assessment not only of what my interlocutors believe but also of what they want, expect, feel etc. Without some sense of what cognitive, affective and (perhaps also) physical state my interlocutors are in prior to my attempt at communication, I can have no idea what effect my linguistic acts will have on their beliefs, feelings and actions. Correspondingly, without some such prior assumptions I cannot rationally take it upon myself to change their psychological state in any particular way by those acts. Furthermore, even given a determination of *what* changes I want to effect, the decision as to *how* to effect those changes requires further assumptions yet. Such assumptions are essential *pre*condiditions for communication.

My main concern in this paper is the problem of giving a general account of the notion of *presupposition*. My general theme is that that notion of presupposition which has been the subject of numerous recent papers by both linguists and philosophers [1] can be adequately explicated only if viewed in the context of such preconditions for communication. Much of the recent literature in this area has failed to pay sufficient regard to what speakers of a language are doing in using that language, attention being directed too quickly away from what a speaker is doing in using a given sentence to properties that that sentence itself is alleged to have. The result has been a tendency to attribute to sentences as semantic properties of those sentences what might better be treated in a theory of the language as pragmatic constraints on their use. Both linguists and philosophers, following in the tracks of Paul Grice (especially his 1967 Harvard lectures [2]), have begun to recognize this. Stalnaker, in

1. For some examples and further bibliographic details, see Filmore and Langendoen (1971).

2. Grice (1975). (This is the first publication of some of the relevant portions of Grice's lectures, which have been circulating in unpublished form since 1967.)